

Economics 497 (L01) (Advanced Econometrics)

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Lecture Location: ZOOM Delivery
Lecture Days/Time: TR 11:00-12:15

Office: ZOOM Delivery
Office Hours: M 9:00 – 10:00

(Winter 2021)

Course Description:

The purpose of this course is to advance students understanding of theoretical and applied issues in econometrics, providing students with a strong foundation to carry through with graduate level study in econometrics and learn the skills sought after in the business community. The course takes a broad approach to topics covered but will also focus on current exciting econometric issues. Students are expected to have a working knowledge of one of the major econometric software packages (e.g., Stata, MATLAB, R, GRETL). The course will cover prediction, cross validation and classification models that are used in Data Science. By the end of the class students will have extensive experience in applying different data analysis methods, and in using experimental and nonexperimental research designs to make inferences. This course starts at a level that assumes familiarity with the material covered in Econ 495 and Stats 213, including proficiency at mathematical statistics and calculus. Matrix algebra is used extensively in lecture presentations.

Course Learning Outcomes:

- a) Know and understand the k-variable regression model.
- b) Be proficient in standard model applications and testing.
- c) Know, understand and be able to prove the Gauss-Markov theorem.
- d) Be able to identify and correct violations to identification and hypothesis testing.
- e) Know and understand standard panel data models allowing for fixed effects.
- f) Know and understand the differences between fixed and random effects estimators.
- g) Know and understand way a randomized experiment allows for a casual interpretation of empirical results.
- h) Know and understand how non-experimental techniques allow for a casual interpretation of empirical results.
- i) Know and understand the use of instrumental variables, difference in differences, matching estimators and discontinuity in identification.
- j) Know and understand the maximum likelihood estimators used in non-linear estimation.
- k) Be proficient in application of prediction, cross validation and classification models.

l) Be proficient in reporting, interpreting, and drawing policy implications from econometric results.

Course Outline:

Broadly, there are two main sections of the course. The first section provides a comprehensive treatment of current econometric methods for causal inference using non-experimental data. The second section introduces students to the theory and practice of machine learning. Significant time in this second section will be spent on learning how to write code in Python. A more detailed breakdown is as follows:

Section 1: Methods for Causal Inference

1. The theoretical concept of causality and the “experimental ideal”
2. The workhorse of econometrics: The Linear Regression model. Review and advanced topics.
3. Advanced topics in Instrumental Variables. Local Average Treatment Effects (LATE).
4. Difference in Differences. Synthetic control.
5. Regression Discontinuity: “Sharp” and “Fuzzy” designs.

Section 2: Machine Learning

1. Introduction to machine learning. Relationship to causal inference.
2. Python – How to write code in Python. Examples using regression.
3. Machine Learning for Prediction. Linear regression-based prediction models. K-fold cross validation.
4. Machine Learning for Classification. K-Nearest neighbors. Decision Trees. Logistic Regression
5. Introduction to Unsupervised learning.
6. Time permitting: Web scraping and Text analysis in Python.

Prerequisites/corequisites:

Econ 497 starts at a level that assumes familiarity with the material covered in Econ 495 and Stats 213, including proficiency at mathematical statistics and calculus. Presentations will extensively use linear algebra. Students are expected to be familiar with Stata software for econometrics. No experience with Python is expected – we will “start from scratch.”

Required Textbook(s):

Angrist, J.D. and Pischke, J., *Mostly Harmless Econometrics: An Empiricist’s Companion*. Princeton University Press.

Recommended Textbook(s):

Wooldridge, J.M., *Introductory Econometrics: A Modern Approach*, South-Western.

There is no required textbook for the machine learning section, I will provide detailed notes. Students may find the following book useful:

Burkov, Andriy, *The Hundred Page Machine Learning Book*.

Online Delivery:

This course will be delivered online. Students are expected to be able to participate online in accordance with this Course Outline. Lectures, assignments, office hours, exams, readings and other course material, etc. all require online access and this access is the responsibility of the student.

In order to remotely participate in online courses, students will need to have: computer with a current and updated operating system (macOS or Windows will work with all university-supported online learning technologies), a current and updated web browser installed – the latest versions of Firefox, Safari, Chrome or Edge will help to avoid compatibility issues, secure and reliable internet, microphone / headphones, webcam (optional), scanner (or camera to scan your work). We will make use of two computer software packages in the course. The first part of the course will require the use of STATA. It is expected that you are proficient with STATA from Econ 495. The second part of the course will use a combination of STATA and Python. I will assume that students have no prior experience with Python, and we will “start from scratch”. Python (and the relevant packages to be used within Python) is free to download.

Desire2Learn:

This course will make use of the Desire2Learn (D2L) platform. Students who are registered in the course can log on at <http://d2l.ucalgary.ca> through their student centre. Please note that D2L features a class e-mail list that may be used to distribute course-related information. These e-mails go to your University of Calgary e-mail addresses only.

Lectures:

Lectures will be delivered online at the Registrar scheduled times and delivered using ZOOM. The lectures will be recorded and subsequently posted to D2L.

Tutorials:

Students are expected to attend “virtually” the tutorial sections to which they have been assigned. Tutorials will be offered online, typically using ZOOM, but can involve moderated discussion boards and curated delivery of alternative online resources. During the tutorials, the TA will discuss pre-assigned questions and additional material relevant to the course that is not covered in lectures.

Grade Determination and Final Examination Details:

| | |
|-----------------|-------|
| MIDTERM EXAM | 20% |
| ASSIGNMENTS (5) | 40% |
| TERM PROJECT | 40% |
| | <hr/> |
| | 100% |

The official grading system will be used. See <http://www.ucalgary.ca/pubs/calendar/current/f-1-1.html>.

A passing grade on any particular component of the course is not required for a student to pass the course as a whole.

In lieu of a traditional “Final Exam,” students will undertake a “term project.” The project will involve taking a problem in empirical economics and applying the tools learned in the course. The subject of the project must have my approval, and you will submit a one page proposal describing your area of study and the approach you plan to take **by the end of January**. I will ask for regular updates to make sure everyone is on track. Students will work on the project throughout the term, and the final product will

be due **after the end of classes**. I will discuss the project and what is expected in much more detail on the first day of class.

If a student's letter grade on the final exam exceeds their midterm(s) letter grade, the weight of the midterm(s) may be transferred to the final exam at the discretion of the instructor. The student must have written the midterm(s) or provided supporting documentation for the absence(s) such as a medical note or statutory declaration.

As per the Writing Across the Curriculum Statement in the Calendar, writing and grading thereof will be a factor in the evaluation of student work. [See https://www.ucalgary.ca/pubs/calendar/current/e-2.html](https://www.ucalgary.ca/pubs/calendar/current/e-2.html).

Course material dealing with a particular assignment will typically be covered in class at least 5 days before the assignment is due; thus, assignments can be completed at any time up to and including the due date. Given these factors, only situations where someone can document illness or domestic affliction for an extended period (i.e., the entire 5 days prior to the due date) would possibly warrant shifting the assignment weight to the final exam. Furthermore, technical problems can be expected to occur with computer systems (and internet availability) so it may be a good idea to not wait until the last minute to submit your assignment.

The midterm exam(s) is take-home exam(s) designed and intended to be completed in 75 minutes. The exam(s) will be open book. The exam(s) will be available on D2L. Student will download the exam from D2L, complete the exam, scan it, and submit using Dropbox in D2L. Student will have 50% time extension to complete the exam, at a time of your choosing, within a 24-hour period determined by the instructor.

All other course components will also be accessed, submitted, and returned through D2L.

If a student cannot write their final exam on the date assigned by the Registrar's Office, they need to apply for a deferred exam <https://www.ucalgary.ca/pubs/calendar/current/g-6.html>. Under no circumstance will this be accommodated by the Department.

Tests and exams WILL NOT involve multiple choice questions and / or fill-in-blank questions.

The exact date for the in-class midterm(s) will be announced at least one week in advance.

THERE WILL BE NO MAKEUP OR DEFERRED QUIZZES/TESTS/EXAMS under any circumstances, nor may the quizzes/tests/exams be written early. Students unable to write the quizzes/tests/exams because of documented illness, family emergency, religious observance, or university-sanctioned event will have the weight shifted to the final examination; otherwise a grade of zero will be assigned.

Reappraisal of Grades and Intellectual Honesty:

For Reappraisal of Graded Term Work, see Calendar I.2

<http://www.ucalgary.ca/pubs/calendar/current/i-2.html>

For Reappraisal of Final Grade, see Calendar I.3

<http://www.ucalgary.ca/pubs/calendar/current/i-3.html>

ACADEMIC MISCONDUCT

Academic Misconduct refers to student behavior that compromises proper assessment of students' academic activities and includes: cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar.

Student committing academic misconduct during the final exam will not receive a passing grade on the course.

For information on the Student Academic Misconduct Policy and Procedure please visit:

<https://ucalgary.ca/policies/files/policies/student-academic-misconduct-policy.pdf>

<https://ucalgary.ca/policies/files/policies/student-academic-misconduct-procedure.pdf>

Additional information is available on the Academic Integrity Website at <https://ucalgary.ca/student-services/student-success/learning/academic-integrity>.

Academic Accommodations:

Students seeking an accommodation based on disability or medical concerns should contact Student Accessibility Services. SAS will process the request and issue letters of accommodation to instructors. Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to their Instructor. The full policy on Student Accommodations is available at <http://www.ucalgary.ca/policies/files/policies/student-accommodation-policy.pdf>.

Freedom of Information and Protection of Privacy (FOIP) Act:

Personal information is collected in accordance with FOIP. Assignments can only be returned to the student and will be accessible only to authorized faculty and staff. For more information, see <http://www.ucalgary.ca/legalservices/files/legalservices/faq-students.pdf> and http://www.ucalgary.ca/legalservices/files/legalservices/faq-faculty_0.pdf.

Copyright Legislation:

See the University of Calgary policy on Acceptable Use of Material Protected by Copyright at <https://www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright-policy.pdf>. Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy.

Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

Recording of Lectures:

Recording of lectures is prohibited, except for audio recordings authorized as an accommodation by SAS or an audio recording for individual private study and only with the written permission of the instructor. Any unauthorized electronic or mechanical recording of lectures, their transcription, copying, or distribution, constitutes academic misconduct. See <https://www.ucalgary.ca/pubs/calendar/current/e-6.html>.

Important Dates:

Please check: <http://www.ucalgary.ca/pubs/calendar/current/academic-schedule.html>.

Student Organizations:

Faculty of Arts Students' Association (F.A.S.A.):

Economics Department Representative

E-mail: econrep@fasaucalgary.ca and Web: www.fasaucalgary.ca.

Society of Undergraduates in Economics:

<https://www.ucalgarysue.com/>.

Society of Undergraduates in Economics is a student run organization whose main purpose is to assist undergraduate economics students to succeed both academically and socially at the University of Calgary. Services include access to the exam bank, career events such as Industry Night and information sessions, mentorship programs, and social events for members. They invite you to join by contacting SUE at societyofundergradsineconomics@gmail.com.

Faculty of Arts Program Advising and Student Information Resources:

- Have a question, but not sure where to start? The Arts Students' Centre is your information resource for everything in Arts! Call them at 403-220-3580, or email them at artsads@ucalgary.ca. You can also visit the Faculty of Arts website at <http://arts.ucalgary.ca/undergraduate>, which has detailed information on common academic concerns, including program planning and advice.
- For registration (add/drop/swap), paying fees and assistance with your Student Centre, contact Enrolment Services at 403-210-ROCK [7625].

Student Support and Resources:

- See <https://www.ucalgary.ca/registrar/registration/course-outlines> for information on campus mental health resources, the Student Ombuds' Office, Student Success Centre, Safewalk, and Emergency Evacuation and Assembly.
- Online writing resources are available at <https://ucalgary.ca/student-services/student-success/writing-support>.

Notes:

1. Students are responsible for all assigned material, e.g., supplementary material posted on D2L, regardless of whether or not the material was covered in class.

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